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COAL RESERVES IN CANADA: 1985

H.G. Naidu
Calgary Coal Research Laboratory

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MICROMEDIA

COAL RESERVES OF CANADA: 1983

by

H.G. Naidu[1]

SUMMARY

The assessment of coal reserves of Canada is done biennially by the Canada Centre for Mineral and Energy Technology (CANMET), Energy, Mines and Resources (EMR). The last assessment on coal reserve tonnages and coal quality was presented in the report ERP/CRL 84-37(TR) dated November 1984 (1).

This report updates the coal reserve tonnages and quality data to December 1985. There is no attempt to update resource tonnages in this report, as this is being undertaken by the Geological Survey of Canada.

Almost all of Nova Scotia's (N.S.) coal reserves are located in the Sydney coalfield. As mentioned in the last report, the Donkin Morien project of Cape Breton Development Corporation had provided a major addition to the recoverable reserves of N.S. Since then there is no significant change.

Coal reserves of New Brunswick remain the same. The difference from the previous report is only the production of 1984 and 1985. There is no change in the status of Onakawana deposit of Ontario, south of James Bay. Due to economic reasons the development of this property for electric generation, is postponed.

In case of Saskatchewan, work on the derivation of coal reserves for Estevan and Willowbunch Coalfields has been completed. The figures in this report are those of the last report less production in 1984 and 1985.

The recoverable reserve tonnages of Alberta have increased due to the revised figures provided by ERCB's report of 1984 on McLeod River and Mercoal Projects. Because of soft coal markets these two projects are on hold.

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[1]Senior Research Engineer, Calgary Coal Research Laboratory,
CANMET, Energy, Mines and Resources, Calgary, Alberta.

Efforts are continuing by some operators to obtain markets for exporting coal generated electric power to U.S.A. If this materializes, the reserves picture will improve further.

In British Columbia, efforts are still continuing on Quinsam and Mt. Klappan projects. There are good possibility of these projects going ahead provided markets are established. There has been no action on the Hat Creek project since the last report. For British Columbia the reserve figures are those presented in the last report less production in 1984 and 1985.

Table 1 summarizes the changes in recoverable coal quantities presented in (1) and this report. Appendix A shows the highlights of Canadian coal industry's performance in 1985.

ÉVALUATION DES RÉSERVES DE CHARBON AU CANADA: 1983

par

H.G. Naidu[1]

RÉSUMÉ

L'évaluation des réserves houillères au Canada est effectuée à tous les deux ans par le Centre canadien de la technologie des minéraux et de l'énergie (CANMET), Énergie, Mines et Ressources (EMR). La dernière évaluation des réserves et de la qualité du charbon a été publiée en novembre 1984 dans le rapport ERP/CRL 84-37 (TR).

Le présent rapport comprend une mise à jour des données sur les réserves et la qualité du charbon jusqu'à décembre 1985 inclusivement mais n'inclut pas les données récentes relatives à l'évaluation des ressources, ces données étant présentement compilées par la Commission géologique du Canada.

La plupart des réserves de charbon de la Nouvelle-Écosse (N.-É.) se trouvent à la houillère de Sydney. Tel que mentionné dans le rapport précédent, le projet Donkin Morien, exploité par la Société de développement du Cap-Breton, a été un apport considérable aux réserves récupérables de la Nouvelle-Écosse. Depuis, aucun changement important ne s'est produit.

Les réserves de charbon du Nouveau-Brunswick n'ont subi aucune modification depuis le dernier rapport, la seule différence se situant au niveau de la production pour les années 1984 et 1985. La situation du gisement d'Onakawana en Ontario, au sud de la Baie de James, est demeurée stable. En raison de la situation économique, le développement de cette concession pour la production d'électricité a été remis à plus tard.

Dans le cas de la Saskatchewan, les travaux relatifs à la dérivation des réserves de charbon des houillères de Estevan et Willowbunch sont terminés. Les chiffres publiés dans le présent rapport sont les mêmes que ceux présentés dans le rapport précédant à l'exclusion des données sur la production pour les années 1984-1985.

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[1]Ingénieur principal de la recherche, Laboratoire de recherche sur le charbon à Calgary, CANMET, Énergie, Mines et Ressources, Calgary (Alberta).

Le nombre des réserves de charbon récupérables de l'Alberta a augmenté parce que les données récentes sur les projets McLeod River et Mercoal ont été tirées du rapport ERCB publié en 1984. En raison de la situation faible du marché, ces deux projets sont en attente. Certains exploitants poursuivent leurs efforts pour trouver des marchés en vue d'exporter vers les États-Unis le pouvoir électrique dérivé de la combustion du charbon.

En Colombie-Britannique, les travaux relatifs aux projets Quinsam et Mt. Klappan se poursuivent. Il est possible que ces projets soient développés si on trouve des marchés pour écouler le produit. Aucune activité n'a été effectuée au projet de Hat Creek depuis le dernier rapport. Les données sur les réserves de la Colombie-Britannique, à l'exclusion des données relatives à la production pour les années 1984-1985, sont les mêmes que celles qui ont été publiées dans le dernier rapport.

Au tableau 1 figure un résumé des changements qui se sont produits au niveau des quantités de charbon récupérables présentées dans (1) et dans ce rapport. Les points saillants concernant la performance de l'industrie du charbon en 1985 sont présentés à l'Annexe A.

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SELECTED CONVERSION FACTORS AND TERMINOLOGY

Multiply this		by this	to obtain	
British thermal unit (Btu)		1055.06	joule	J
Btu per pound		2.326	kilojoule per kilogram	kJ/kg
cubic yard		0.764 555	cubic metre	m^3
cubic yards per ton		0.842 78	cubic metres per tonne	m^3/t
foot		0.304 8	meter	m
joule	J	0.000 947 8	Btu	
kilojoule per kilogram	kJ/kg	0.429 923	Btu per pound	
kilometre	km	0.621 371	mile	
litre per second	L/s	13.1982	gallon per minute	
megajoule per kilogram	MJ/kg	429.923	Btu per pound	
metre	m	3.280 84	foot	
mile		1.609 344	kilometre	km
short tonne per acre foot		7.354 67	tonne per hectare metre	t/ham
ton (long)		1.016 046 9	tonne	t
ton (short)		0.907 184 7	tonne	t
tonne		0.984 206 5	long ton	
tonne		1.102 311	short ton	

SI PREFIXES

Multiplying Factor	Prefix	Symbol
1 000 000 000 000 000 000 = 10^{18}	exa	E
1 000 000 000 000 000 = 10^{15}	peta	P
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^{9}	giga	G
1 000 000 = 10^{6}	mega	M
1 000 = 10^{3}	kilo	k
100 = 10^{2}	hecto	h
10 = 10^{1}	deca	da

1. INTRODUCTION

1.1 BACKGROUND

This report is the fifth in a series that started in 1976 on the assessment of Canada's coal resources and reserves in terms of quantity and quality. The first two reports EP77-5 (4) and ER79-9 (5) included contributions from other branches of EMR. The last update was given in CANMET's divisional report ERP/CRL 84-37(TR) (1) which focussed on coal reserves along with coal quality data for 1983. This report updates the coal reserves as of December 31, 1985 following EMR's definition of what constitute coal reserves - which is in line with EMR's assessment of the nation's uranium, precious metal and base metal reserves.

Since the publication of 1983 report, the only change in the recoverable coal reserves is in Alberta due to the inclusion of revised figures of the McLeod River and Mercoal Projects. These projects have received approvals from Alberta's Energy Resources Conservation Board (ERCB) but are on hold due to diminishing export coal markets.

Since the publication of the last report (1), there has been a big increase in the export of coal. Compared to 17 Mt in 1983, Canada exported about 27 Mt in 1985. The increase was mainly due to the new mines in Western Canada. On the other hand there have been further cuts in the volume of imports from the existing suppliers by Japanese buyers. This has forced many Canadian suppliers to restrict their mine production. In 1985, three underground mines namely No. 26 mine of CBDC, N.S; Michel hydraulic mine of Westar Mining, B.C. and Drummond Mine in N.S; were closed down due to outbreaks of fire. The underground exploratory drivages of both Coal Valley and Luscar mines were suspended. The surface mine of NOVACO at Pt. Aconi, N.S. closed down as the reserve became exhausted. However, during this period two new surface mines opened up: Obed Marsh mine in Alberta and Drummond surface mine in N.S. The mines in North East B.C. expanded to reach their designed capacities, with only Bullmoose Mine reaching its production target. The Quintette mine experienced some difficulty and could reach only 90% of designed capacity. There was increase in the production of sub-bituominous coal in Alberta.

Saleable coal production in 1985 was 60.48 million tonnes compared to 57.4 million tonnes in 1984, an increase of 5.4%. The main increase was in B.C. and Alberta.

With the crashing of oil prices, the future of the coal industry continues to be bleak. Canada needs continued measures for enhancing productivity and reducing costs, to maintain its share of world markets.

Units of measurement presented in this report are those given in the International System of Units (SI) as approved for official use by the Canadian Standards Association and Metric Commission Canada. These units have been adopted by The Mining Association of Canada and The Coal Association of Canada to promote correct and uniform use of SI in mining, milling, smelting and refining operations in Canada. These two associations have published a report (6) from which most of the prefixes, terminology and conversion factors listed on page (vi) were selected.

1.2 CURRENT OBJECTIVES OF EMR AND CRL

For making policy statements and demand forecasts the policy makers in the federal government need answers to the general question: how much coal of what quality can be recovered in Canada from where and at what relative cost. This report represents part of CANMET's contribution of technical information and data needed to answer this complex question.

The project's objective is to assess both the recoverable reserves of Canada and production and to publish the results biennially. There were two project elements for the fiscal year 1985-86, summarized as follows:

Project Element	Objective
Reserve assessment	Compile data on coal reserves, representative qualities, limiting criteria, and likely mining methods for each coal field or coal region
Productivity assessment	Gather data on selected coal producing regions in Canada which will serve as the basis for identifying technical constraints to expand production and assessing production potential.

The likely clients for this work, as reported herein, have been identified as:

- EMR and provincial energy policy groups.
- Coal development and mining companies
- Trade officials
- The Coal Association of Canada

Table 1 - Recoverable coal reserves of immediate interest by province

Province/ Region	Recoverable coal reserve ($x10^6t$) *1983 Report	*1985 Report	Difference	Remarks
Nova Scotia	437.4	431.3	6.1	Prod. in 1984 and 1985
New Brunswick	4.65	3.6	1.05	Do
Ontario	0	0	0	0
Saskatchewan	1682	1662	-20	Prod. in 1984 and 1985
Alberta				
Plains	901.5	865.5	-36	Do
Foothills	570.8	796	+225	Increase due to revised figures of McLeod and Mercoal Projects.
Mountains	247.5	232	-15.5	Prod. in 1984 and 1985
British Columbia				
Bituminous	2062.5	2005	-57.5	Do
Lignitic	566	566	0	
Canada Total:				
Lig	2248	2228	-20	
Sub	901.5	865.5	-36	
Bit	3322.8	3467.9	+145.1	
Bituminous Metallurgical included in Bituminous above				
Nova Scotia	131	128		
Alberta	247.5	232		
British Columbia	1615.0	1580		
Total Metallurgical	1993.5	1940		

*Report ERP/CRL 84-37(TR) "Coal reserves in Canada: 1983 by H.G. Naidu, November 1984, (1).

1.3 SOURCES OF DATA AND INFORMATION AND ACKNOWLEDGEMENT

Originally, the data on Canada's Coal reserves, as reported in Report (5) were based on information gathered from different mine operations and coal-lease holders through a standard questionaire and on published information to January 1, 1977. This was followed with a divisional report (3) which included information up to December 1981 obtained through personal visits to mining operations and developments across Canada. The last update was report (1) published in November 1984.

One project from construction/development stage moved to the category of operating mines as listed below:

- Obed Marsh mine - Foothills Region, Alberta

The author wishes to acknowledge assistance from Alberta's Energy Resources Conservation Board and the Mineral Resources Branch of B.C.'s Ministry of Energy, Mines and Petroleum Resources. The author wishes to thank the managers of coal mines who provided the necessary information. The author also wishes to thank A.S. Romanuik for his valuable contribution and guidance in preparing this report.

The cooperation of the Statistics Section of Energy Strategy Division in EMR and of the Energy and Minerals Section of Economic Statistics Division in Statistics Canada in providing data on coal production is acknowledged.

2. COAL RESERVES

2.1 COAL RESERVES BY PROVINCE/COAL REGION/COALFIELD

Table 2 shows Coal reserve quantities based on the definition stated in Appendix "B". These represent a part of the resources of immediate interest as defined in Appendix 'B', except for Alberta's resource numbers for which explanation is given in the following paragraphs. Along with the reserves, coal resources of immediate interest has also been tabulated to provide a better picture to the readers to know the source from which the reserve quantities have been derived. For this purpose, only the resources which fall within the Measured and Indicated Catagories have been provided. According to the definitions given in Appendix B, all the resources catagorized as "Inferred" has been excluded as these have resources of future interest.

Alberta Energy Resource Conservation Board (ERCB) has the responsibility of assessing province's coal reserves and resources and report annually (8).

The criteria and procedures used by ERCB are different from those used by Energy, Mines and Resources as such a direct correlation between the two systems is not possible. The reserve quantities f Alberta provided in TAble 2 has been taken from ERCB's Report (8). This table include only those resource quantities which ERCB utilized for calculating reserves using the mining criteria mentioned in the stated report (8). Resources where according to report (8), deposits are considered to have no recoverable Coal, have been excluded.

Alberta's reserves quantities as shown in Table 2 are those defined by ERCB as "mine permit reserves". To commence mining of coal in Alberta, the potential developer is required to obtain a permit and license from ERCB. The application for permit is required to contain a detailed site-specific information on in-situ coal quantities, proposed mining methods, coal quality, marketing of coal etc. This is very much equivalent to an engineering feasibility study on the property.

2.2 COAL RESERVES BY RANK

This is presented in Table 3. Tonnage figures for British Columbia and for Canada as a whole have purposely not been totalled, because such summations would include coal of various ranks which, when lumped together, give a number with little meaning. Totals can more usefully be expressed in terms of heating value, as shown in Table 3. Coal deposits with less than 2 megatonnes recoverable coal have been excluded from this table.

2.3 COAL RESERVES BY LIKELY MINING METHOD

The mining methods identified for individual coal deposits in engineering feasiblity studies are presented in Table 4. The two surface mining methods refer to the basic way overburden is stripped from the coal, and not how coal is excavated.

3. PRODUCTION

3.1 OPERATING COAL MINES AND PROJECTS UNDER DEVELOPMENT AS OF DECEMBER 31/85

Coal operations range from established producers in historical coalfields to likely prospects in entirely new regions. Appendix "C" presents this information in three groupings, by coalfield, namely:

Part I: Operating Coal Mines

Part II: Coal Projects in the Construction-Development Stage

Part III: Coal Projects in the Planning-Development Stage

What constitutes a project in the planning-development stage can be a matter of opinion. For projects in Alberta and British Columbia, the provincial government's assessment procedure provides a useful measure of the degree to which individual projects have advanced. The step-by-step assessment of projects moving from exploration prospects to operating coal mines is detailed in references (9) and (10) for Alberta and British Columbia respectively.

Table 2 - 1985 Coal reserves in Canada, in megatonnes as of Dec. 31/85
(for definition of resource/reserve terminology see Appendices B and C)

Province	Coalfield	*Coal rank	Resources of immediate interest	Coal in mineable seams	Recoverable coal	Clean coal	Remarks
NOVA SCOTIA	Cumberland-Springhill	hvb	2.5	0.1+	0.1+	NA	
	Inverness	hvb	2.4	2.3	1.1	NA	
	Pictou	hvb	0.2	0.2	0.1	NA	
	Sydney	hvb	965	786	430	330	
	TOTAL		970.1	788.6	431.3	330	
NEW BRUNSWICK	Minto	hvb	10.6	3.7	3.6	NA	
ONTARIO	Onakawana	hvb	218	0	0	NA	
SASKATCHEWAN	Estevan	lig	490)	)	1 662	NA	
	Willow Bunch	lig	1 671)	2076)		NA	
	Wood Mountain	lig	1 011)	)		NA	
	Cypress	lig	569)	)		NA	
	TOTAL		3 741	2076	1 662	NA	
ALBERTA PLAINS	Barrhead	sub	410	NA	NA	NA	
	Battle River	sub	2 100	134	71.5	NA	
	Blackfoot	sub	179	NA	NA	NA	
	Bow Island	sub	34	NA	NA	NA	
	Brooks	sub	192	NA	NA	NA	
	Buffalo Hill	sub	630	NA	NA	NA	
	Chain Lakes	sub	30	NA	NA	NA	
	Comrey	sub	9	NA	NA	NA	
	Cypress Hills	lig	33	NA	NA	NA	
	Drumheller	sub	803	41	10	NA	
	East Brooks	sub	120	NA	NA	NA	
	East Edmonton	sub	996	NA	NA	NA	
	Fox Creek	sub	1 267	NA	NA	NA	
	Garden Plain	sub	57	NA	NA	NA	
	Grassy lake	sub	53	NA	NA	NA	
	Hussar	sub	120	NA	NA	NA	

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Table 2 - 1985 Coal reserves in Canada, in megatonnes as of Dec. 31/85
(for definition of resource/reserve terminology see Appendices B and C)

Province	Coalfield	*Coal rank	Resources of immediate interest	Coal in mineable seams	Recoverable coal	Clean coal	Remarks
ALBERTA PLAINS	Lesser Slave Lake	lig	69	NA	NA	NA	
	Lethbridge	hvb	260	NA	NA	NA	
	Lucky Strike	sub	16	NA	NA	NA	
	Mayerthorpe	sub	1 139	3.1	2.0	NA	
	Medicine Hat	sub	247	NA	NA	NA	
	Morinville	sub	977	12.7	8.3	NA	
	Musreau Lake	hvb	37	NA	NA	NA	
	Red Deer	sub	1 808	NA	NA	NA	
	Rolling Hills	sub	130	NA	NA	NA	
	Sheerness	sub	200	170	126	NA	
	South Swan Hills	sub	527	0	0	NA	
	Standard	sub	12	NA	NA	NA	
	Taber	sub	12	NA	NA	NA	
	Thorhild-Abee	lig	26	1.6	1.2	NA	
	Tofield-Dodds	sub	1 650	1.3	1.0	NA	
	Wabamun	sub	2 168	640	481	NA	
	Wetaskiwin	sub	2 021	249.7	154.6	NA	
	Isolated Deposits	lig-hvb	133	NA	NA	NA	
	TOTAL		18 465	1 253	865.5	NA	
ALBERTA FOOTHILLS	Coalspur (Coal Valley	hvb					
	and Mercoal)	hvb	1 326	445	314	70	plus new
	Hannington	NA	216	NA	NA	NA	figures
	McLeod River	hvb	387	387	330	NA	from ERCB
	Obed Mountain	hvb	214	193	152	90	ST-85-31
	Turner Valley	hvb	13	NA	NA	NA	Do
	Isolated Deposits	hvb	62	NA	NA	NA	Do
	TOTAL			1 025	796	160	Plus

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Table 2 - 1985 Coal reserves in Canada, in megatonnes
(for definition of resource/reserve terminology see Appendices B and C)

Province	Coalfield	*Coal rank	Resources of immediate interest	Coal in mineable seams	Recoverable coal	Clean coal	Remarks
ALBERTA MOUNTAINS	Beaver Mines	hvb	11	NA	NA	NA	
	Bellevue	hvb	135	NA	NA	NA	
	Blairmore	mvb	476	NA	NA	NA	
	Brule	lvb	51	NA	NA	NA	
	Cadomin-Luscar	mvb	375	161	77	60.0	
	Canmore	lvb	455	NA	NA	NA	
	Coleman	mvb	374	NA	NA	NA	
	Daisy Creek	NA	85	NA	NA	NA	
	Kakwa River	ivb-hvb	101	NA	NA	NA	
	Kananaskis	NA	80	NA	NA	NA	
	Mountain Park	hvb	140	NA	NA	NA	
	Nordegg	lvb	233	NA	NA	NA	
	Oldman River	NA	353	NA	NA	NA	
	Ram River	NA	379	NA	NA	NA	
	Savanna Creek	NA	133	NA	NA	NA	
	Smoky River	lvb	880	390	155	110	
	Tent Mountain	mvb	93	NA	NA	NA	
	Isolated Deposits	lvb	441	NA	NA	NA	
	TOTAL		4 795	551	232	170	
BRITISH COLUMBIA	Comox	hvb	30	16	15	10	
	Crowsnest	lvb-mvb	575	550	438	370	
	Elk Valley	lvb-hvb	8 450	1 123	1 066	707	
	Flathead	lvb-mvb	132	NA	NA	NA	
	***Hat Creek	lig-sub	1 739	739	566	NA	
	Peace River	mvb	1 760	725	486	340	
	TOTAL		12 686	3 153	2 571	1 427	

* lig=lignitic; sub=subbituminous; lvb= low volatile bituminous; mvb=medium volatile bituminous; hvb=high volatile bituminous

** The figures of Mercoal and Mcleod River are based on the application made to ERCB and ERCB's decision in April/83 and Feb/83 respectively

*** The project is put on hold indefinitely

Table 3 - 1985 coal reserves in Canada by Rank

Rank Region Coalfield	Coal in mineable seams (megatonnes)	Recoverable coal (megatonnes)	Recoverable coal heating value (petajoules)
LIGNITIC			
Saskatchewan			
All coalfields	2 076	1 662	23 310
British Columbia			
Hat Creek	739	566	6 800
Sub-Total, Lignitic	2 815	2 228	30 110
SUBBITUMINOUS			
Alberta			
Battle River	134	71.5	1 384
Drumheller	41	10	200
Morinville	12	8	100
Sheerness	170	126	2 100
Wabamun	640	491	9 096
Wetaskiwin	250	155	2 900
Others	6	4	100
Sub-Total, Subbituminous	1 253	865.5	15,880
BITUMINOUS			
Nova Scotia	788.6	431	11 670
Sydney			
New Brunswick			
Minto	3.7	3.6	126
Beersville	13.6	12.2	350
Alberta			
Coalspur	445	314	7 005
Obed Mountain	193	152	2 901
Cadomin Luscar	161	77	1 966
Smoky River	390	155	3 851
Mcleod River	387	330	NA
British Columbia			
Comox	16	15	400
Crowsnest	550	438	10 950
Elk Valley	1 123	1 066	26 602
Peace River	725	486	12 126
Sub-Total, Bituminous	4 796	3 480	77 947
TOTAL, All Ranks	8 864	6 571.5	123 937
BITUMINOUS METALLURGICAL, included in BITUMINOUS above			
Nova Scotia	236	128	
Alberta	552	232	
British Columbia	2 100	1 580	
TOTAL, Metallurgical	2 888	1 940	

Table 4 - 1985 coal reserves in Canada, by likely mining method in megatonnes

Rank Province Coalfield	Recoverable coal	Surface methods		Underground methods		
		shovel/ truck	dragline	longwall	room & pillar	hydraulic
LIGNITIC						
Saskatchewan						
All coalfields	1 662		1 662			
British Columbia						
Hat Creek	566	566				
Sub-Total, Lignitic	2 228	566	1 662			
SUBBITUMINOUS						
Alberta						
Battle River	71.5		71.5			
Drumheller	10			10		
Sheerness	126		126			
Wabamun	491		491			
Wetaskiwin	155		155			
Others	16	16				
Sub-Total, Subbituminous	869.5	16	843.5	10		
BITUMINOUS						
Nova scotia						
Cumberland-Springhill	0.1	0.1				
Inverness	1.1				1.1	
Pictou	0.1				0.1	
Sydney	431.5					
New Brunswick						
Minto	3.6		3.6			
Alberta						
Coalspur	314	273	22	18	1	
Obed Mountain	152	52	100			
Cadomin-Luscar	77	58			9	10
Smoky River	155	90			65	
Mcleod River	330	330				
British Columbia						
Comox	15	6	9		2	64
Crowsnest	438	372				
Elk Valley	1 066	1 056	10			
Peace River	486	400			86	
Sub-Total, Bituminous	3 469.4	2 631.1	144.6	449.5	164.2	74
TOTAL, by Mining Method	6 566.9	3 213.1	2 650.1	459.5	164.2	74

4. LITERATURE REFERENCES

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APPENDIX A

APPENDIX A - PERFORMANCE OF CANADIAN COAL INDUSTRY: 1985

No. of operating mines*	- 30 (surface 25 ad underground 5)
Largest mine and its production	- Highvale Mine, Alberta (surface) - 11.5 mt tonnes
Largest producer	- Manalta Coal Ltd. - 24,562,000 Raw Tonnes
Province with maximum number of mines	- Alberta, 12 mines
Province with maximum production	- Alberta, 27.7 Mte-raw, - 24.4 Mte-saleable
Province with maximum coal value produced	- British Columbia, $1,101.7 million
Operator with maximum manpower	- Cape Breton Development Corporation - approx.
Province with highest mine productivity	- Saskatchewan, dragline stripping - 24,794 Tonnes per man year

*mines with over 30 000 tonnes per year production are only included.

APPENDIX B

APPENDIX B - DEFINITION OF MEASURED AND INDICATED COAL RESOURCES

The definition for coal whose assurance of existence is described by the terms MEASURED and INDICATED varies from region and region, according to topographical and geological conditions. The following is a part of the resource classification system used by the Geological Survey of Canada and presented in Report ER 79-9 (5).

Measured Resources are resources for which tonnages are computed from information revealed in outcrops, trenches, mine workings and boreholes. The spacing of points ob observation necessary to justify confidence in the character and continuity of coal seams differs from region to region according tothe character of the deposits and the geological conditions. In general the points of observation should be separated by less than the following distances:

Coal regions in Canada	Maximum distance between points of observation (in metres)
Cordillera	300 (150 m in severely contorted areas)
Plains Alberta	800
Saskatchewan	800
New Brunswick	400
Nova Scotia	
Sydney Coalfield, offshore	
Harbour and Phalen seams	1 600
Other seams	800
Sydney Coalfield, onshore	800
Other coalfields	300

Indicated Resources are resources for which tonnages are computed partly from specific measurements and partly from reasonable geological projections. For the general coal regions in Canada, the points of observation should be separated by less than the following distances:

Coal regions in Canada	Maximum distance between points of observation (in metres)
Cordillera	600 (300 m in severely contorted areas)
Plains	
Alberta	1 600
Saskatchewan	1 600
New Brunswick	800
Nova Scotia	
Sydney Coalfield, off shore	
Harbour and Phalen seams	4 800
Other seams	1 600
Sydney Coalfield, onshore	1 600
Other coalfield	600

Note 1: Cordillera region includes all British Columbia and the Foothilss and Mountain regions of Alberta.

Note 2: This CANMET report is not concerned with coal categorized as "inferred" or "speculative" as such coal is not within the coal supply picture which this report is attempting to portray. For the same reason this report is not concerned with "resources of future interest".

Inferred Resources are resources for which quantity estimates are based largely on broad knowledge of the geologic character of the bed or region and for which few measurements of seam thickness are available. The estimates are based primarily on an assumed continuity of coal seams in areas remote from the points of observation used to calculate measured or indicated resources.

APPENDIX C

APPENDIX C - DEFINITION OF COAL RESERVES

The terminology used in this report is similar to that given in Report ER 79-9, (3) excepting that "mineable coal" has been replaed by the term COAL IN MINEABLE SEAMS.

COAL IN MINEABLE SEAMS is that part of measured and indicated resources of immediate interest that can be considered for mining using current technology and econmics, before there is any allowance for mining losses. To qualify as COAL IN MINEABLE SEAMS the following conditions must apply:

- that feasibility studies have been done, specific plans for mining method and processing (if needed) have been adopted and the overall economic feasibility for developing the coal deposit appears favourable.
- that the necessary infrastructure (townsite, power and transportation facilities) is either in place or can be amortized through coal sales.
- that the coal is legally accessible for excavation i.e. the development considered is beyond the prospectus or initial disclosure stage in the regulatory process and has received approval-in-principle from the provincial government concerned.
- that all coal being considered for development is likely to be marketable at minimum acceptable profit levels.

RECOVERABLE COAL is that part of COAL IN MINEABLE SEAMS that would be recoverable as run-of-mine or raw coal, making allowances for mining losses. For example, in surface mining, a portion of the top if a seam will likely be lost with overburden in the strippin operation, or a part of the seam next to the spoil pile will not likely be excavated. In underground operations the most common mining loss is associated with pillars left as supports or barriers.

CLEAN COAL is that part of RECOVERABLE COAL that remains as the prime saleable product after upgrading in a preparation plant.

SALEABLE COAL is coal that meets saleable specifications; it may be clean coal with acceptable moisture content or raw coal that is ready to be used without further upgrading.

APPENDIX D

APPENDIX D - Operating Coal Mines and Mines under Development as of Dec. 31/85
(Part I: Operating Coal Mines; Part II: Coal Projects in the Construction-Development Stage: Part III: Coal Projects in the Planning-Development Stage)

PART I: Operating Coal Mines (continued)

Coalfield/Mine	Owner/Operator	Mining Method	Coal Rank & Seam(s)	1985 Raw Coal Production, Tonnes
NOVA SCOTIA				
Sydney Coalfield				
Lingan Mine	Cape Breton Development Corporation (CBDC)	Advancing longwall Some room-and-pillar	hvbA; Harbour SEam; 1-3% sulphur	1,906,000tpy metallurgical & thermal
No. 26 Colliery	CBDC	Advancing longwall	hvbA; Hub Seam; 1-2% sulphur	shut down due to mine fire
Prince	CBDC	Retreating longwall (short-faces); room-and-pillar (development)	hvbA; Hub Seam; 3-5% sulphur	994,000tpy thermal
Pit at Pt. Aconi	Thomas Brogan & Son	Strip mining	hvbA	33,000tpy.
Pit at Pt. Aconi Novaco	NOVACO	Dragline stripping	hvbA Sydney Main Seam; 3-5% sulphur	53,000tpy thermal closed down as the reserves exhausted
SELMINCO	Discard dump reclamation at Sydney Mines	Loader/trucks	hvbA; Sydney Main Seam; 1-5%	50,000tpy thermal
SUMMIT Coal Co			hvb	108,000tpy thermal
Inverness Coalfield				
St. Rose Mine	Evans Coal Mines Ltd.	Room-and-pillar	hvbB; No. 5 Seam; 4-5% sulphur	29,000tpy thermal
NEW BRUNSWICK				
Minto/Chipman Area Pits	New Brunswick Coal Co.	Dragline strip mining	hvbA: Single thin seam; 6-8% sulphur	555,000tyy
SASKATCHEWAN				
Estevan Coalfield				
Bienfait Mine	Bienfait Coal Co. Ltd. (Luscar Ltd. subsidiary)	Dragline strip mining	ligA; single seam in the Estevan Zone; 0.4-0.6% sulphur	1,386,000tpy thermal
Boundary Dam Mine	Manitoba & Saskatchewan Coal Co. Ltd.(Luscar Ltd.	Dragline strip mining	ligA; 2 seams in the Estevan Zone; 0.4-0.6% sulphur	2,087,000tpy thermal
Costello Mine	Manalta Coal Ltd.	Dragline strip mining	ligA; single seam Estevan Zone; 0.4-0.6% sulphur	294,000tpy thermal

PART I: Operating Coal Mines (continued)

Coalfield/Mine	Owner/Operator	Mining Method	Coal Rank & Seam(s)	1983 Raw Coal Production, Tonnes
Utility Mine	Manalta Coal Ltd.	Dragline strip mining	ligA; one seam in the Estevan Zone; 0.4-0.6% sulphur	2,400,000tpy thermal
Willow Bunch Coalfield				
Poplar River Mine	Manalta Coal Ltd.	Dragline strip mining	ligA; one seam in the Hart Zone 0.5% sulphur	3,800,000tpy thermal
ALBERTA'S PLAINS REGION				
Battle River Coalfield				
Diplomat Mine (No. 1578)	Forestburg Collieries Ltd. (Luscar Ltd. subsidiary)	Dragline strip mining	subC; Paintearth Seam; 0.4% sulphur	62,000typ
Paintearth Mine (No. 1781)	Forestburg Collieries Ltd. (Luscar Ltd. subsidiary)	Shovel/dragline strip mining	subC; Single Seam; 0.4% sulphur	1,539,000tpy
Vesta Mine (No. 1046)	Alberta Power Ltd. (Manalta Coal Ltd. operator)	Dragline strip mining	subC; Single Seam; 0.4% sulphur	1,143,000tpy thermal
Sheerness Coalfield				
Montgomery Mine (No. 443)	Manalta Coal Ltd.	Dragline strip mining	subC; Single Seam; 0.4% sulphur	296,000tpy thermal (capacity 400 000 tpy)
Wabamun Coalfield				
Highvale Mine (No. 1769)	TransAlta Utilities Ltd. (Manalta Coal Ltd. operator)	Dragline strip mining	subB; up to five seams; 0.3% sulphur	11,842,000tpy thermal
Whitewood Mine (No. 1757)	TransAlta Utilities Ltd. (Fording Coal Ltd. operator)	Dragline strip mining	subB; up to five seams; 0.3% sulphur	1,950,000tpy thermal
Tofield-Dodds Coalfield				
No. 215 Mine	Dodds Coal Mining		subC	
Morinville Coalfield				
No. 1582 Mine	Egg Lake Coal Co. Ltd.		subC	41,200tpy
Thorhild-Abee Coalfield				
No. 1562 Mine	North Point Coal Co. Ltd.		ligA	
Red Deer Coalfield				
No. 809 Mine	Sissons Mine Ltd.		subA/B)	
Wetaskiwin Coalfield				
No. 1670 Mine	Warburg Coal Co. Ltd.		subA/B)	

PART I: Operating Coal Mines (continued)

Coalfield/Mine	Owner/Operator	Mining Method	Coal Rank & Seam(s)	Production, Tonnes	
ALBERTA'S FOOTHILLS REGION					
Coalspur Coalfield					
Coal Valley Mine (No. 1778)	Luscar Sterco (1977) Ltd. (75% Luscar Ltd. 25% Alberta Energy Co. Ltd.	Shove-truck and dragline stripping	hvbC/B; Val D'Or/Hyaheer Hyaheer Seam; 0.3% sulphur	3,300,000tpy thermal	
Obed Marsh Coalfield					
Obed Marsh Mine (No. 1791)	Union Oil Co. of Canada	Dragline stripping	hvbc seams 1 and 2 0.5% sulphur	1,356,000tpy	
ALBERTA'S MOUNTAIN REGION					
Cadomin-Luscar Coalfield					
Luscar Mine (No. 1768)	Cardinal River Coals Ltd. (50% Luscar Ltd. 50% Consolidation Coal Co. of Canada	Shovel-truck stripping	mvb; Jewel Seam; 0.3% sulphur	2,390,000tpy metallurgical (capacity 3,000,000tpy)	
Smoky River Coalfield					
No. 1774 Mine	McIntyre Mines Ltd. Smokey River Coal Ltd.	Shovel-truck stripping	lvb; Seams No. 4,10,11; 0.4-0.5% sulphur	597,000tpy; some thermal and metallurgical	
No. 1765 Mine	McIntyre Mines Ltd. Smokey River Coal Ltd.	Room-and-pillar 0.4-0.5% sulphur	lvb; Seams No. 4,11; metallurgical	300,000tpy	
Gregg River Project (No. 1770)	Gregg River Resources Ltd. (Manalta Coal Ltd. and others)	Shovel-truck stripping	mvb; Jewel Seam; 0.3% sulphur	2,837,000tpy metallurgical;	
BRITISH COLUMBIA					
Crowsnest Coalfield					
Harmer Surface Mine	Westar Mining Ltd.	Shovel-truck stripping	lvb; 10 Seam and 8 Seam; 0.3-0.5% sulphur and metallurgical	9,020,000tpy; some thermal	
Michel Underground Mine	Westar Mining Ltd.	Hydraulic; some room-and-	lvb; 10 Seam; 0.3-0.5% lvb; 10 Seam; 0.3-0.5%	190,000tpy metallurgical coal	The hydraulic mine was shut down due to fire(Jan./85)
Coal Mountain Mine	Byron Creek Collieries Ltd. (Esso Minerals Canada subsidiary)	Loader/trucks	mvb; Mammoth Seam; 0.2-0.3% sulphur	1,173,000tpy thermal	
Elk Valley Coalfield					
Fording River Mine	Fording Coal Ltd.	Shovel-truck stripping and dragline stripping	lvb, mvb, hvb; Seams; 0.3-0.5% sulphur	6,480,000tpy	
Greenhills Project	B.C. Coal Ltd./Pohang Iron Steel Co. Ltd.	Shovel-truck stripping	mvbvA and hvbA; Seams No. 1,7,10, 16 and others; 0.3-0.5%	3,089,00tpy some thermal and metallurgical	
Line Creek Project	Crowsnest Resources Ltd. (Shell Canada Resources Ltd. subsidiary)	Shovel-truck stripping	lvb and mvb; Seams 8,9,10B, 10A and others; 0.3-0.5% Sulphur	2,780,000tpy thermal and metallurgical;	

PART I: Operating Coal Mines (continued)

Coalfield/Mine	Owner/Operator	Mining Method	Coal Rank & Seam(s)	Projected Annual Raw Coal Production, Tonnes
Peace River Coalfield				
Bullmoose Project	Teck Corporation/Amalgamated Bramalea-Yukon Ltd.	Shovel-truck stripping	mvb; five seams; 0.3-0.5% Sulphur sulphur	2,857,000tpy thermal
Quintette Project	Denison Mines Ltd. and partners	Shovel-truck stripping some dragline stripping	mvb; multi-seams; 0.3-0.5% sulphur	8,970,000tpy metallurgical 1,125,000tpy thermal

PART II: Coal Projects in the Construction-Development Stage

NOVA SCOTIA				
Sydney Coalfield				
Donkin-Morien Project	CBDC	Advancing longwall	hvbA; Harbour Seam; 1-3% sulphur	Projected output of 3,000,000 tpy of thermal by 1987
Lingan-Phalen Project	CBDC	Advancing longwall	hvbA; Phalen Seam; 1-3% sulphur	Projected output of 2,000,000tpy of thermal coal and metallurgical coal by 1987
ALBERTA'S FOOTHILLS REGION				
Coalspur Coalfield				
Silkstone Project (No. 1796)	Luscar Sterco (1977) Ltd. (75% Luscar Ltd. 25% Alberta	Room-and-pillar	hvbC; Upper and Lower Silkstone Seams	700,000 tpy; thermal; the project is on hold.
ALBERTA'S MOUNTAIN REGION				
Cadomin-Luscar Coalfield				
Hydraulic Mine Project (No. 1792)	Cardinal River Coals Ltd. (50% Luscar Ltd. 50% Consolidation Coal Co. of Canada)	Hydraulic mining	mvb: Jewel Seam; 0.3% sulphur	1,300,000 tpy; metallurgical; the project is on hold.

PART III: Coal Projects in the Planning-Development Stage

ALBERTA'S PLAINS REGION				
Lethbridge Coalfield				
Kipp Project (No. 1787E)	Petro-Canada	Room-an-Pillar or Shortwall/longwall	hvbC; Galt Seam; 0.6% sulphur approx.	Thermal coal
Shaughnessy Project	Fording Coal Ltd.	Room-an-Pillar or Shortwall/longwall	hvbC; Galst Seam; 0.6% sulphur approx.	Thermal coal
Sheerness Coalfield				
Sheerness Project (No. 1782)	Forestburg Collieries Ltd. (Luscar Ltd. subsidiary) and Manalta Coal Ltd.	Dragline stripping	subC: one main seam with splits and some from an upper seam; 0.4% sulphur	Projected output of 3,300,000 tpy of thermal coal in 1986
South Swan Hills Coalfield				
Judy Creek Project (No. 1783E)	Esso Minerals Canada	Dragline stripping	subC; Seams No. 3,5,7 and others; 0.3% sulphur	Thermal coal

PART III: Coal Projects in the Planning-Development Stage (continued)

Coalfield/Mine	Owner/Operator	Mining Method	Coal Rank & Seam(s)	Remarks
Wetaskiwin Coalfield				
Genesee Project (No. 1785)	Edmonton Power (Fording Coal Ltd. operator)	Dragline stripping	subA and subB; Upper Main and Lower Main Seams; 0.3-0.4% sulphur	Projected output of 3,000,000 tpy of thermal coal starting in 1987
BRITISH COLUMBIA Comox Coalfield				
Quinsam Project	Brinco/Weldwood of Canada Ltd.	Dragline, as well as shovel-truck stripping	hvbA; Seams No. 1 and 2 some Seam No. 3; 1.1% sulphur	Thermal; (addendum to Stage II report in preparation)
Elk Valley Coalfield				
Elk River Project	Elco Mining Ltd. (a consortium plus other partners	shovel-truck stripping	lvb, mvb and hvb; multiple seams; 0.6% sulphur Feb/79)	Metallurgical and thermal; (Stage II report approved
Flathead Coalfield				
Sage Creek Project	Rio Algom Ltd./Pan Ocean Ltd.	shovel-truck stripping	lvb to mvb; Seams No. 2,4, Upper, 4 Lower and 5; 0.5% sulphur	Metallurgical and thermal; (Stage II report in preparation)
Hat Creek Coalfield				
Hat Creek Project	B.C. Hydro and Power Authority	Shovel-truck stripping	lig to sub; four coal zones; 0.3-0.5% sulphur	Thermal; (Stage II report under review). Delayed indefinitely.
Groundhog Coalfield				
Mr.. Klappan	Gulf Canada	Shovel-truck Stripping	Semi-Anthracite	Export
Peace River Coalfield				
Burnt River Project	Teck Corporation	Shovel-truck stripping	ss; from three to six seams; 0.3-0.5% sulphur	Thermal; (Stage II report in preparation)
Carbon Creek Project	Utah Mines Ltd.	Longwall; also shovel-truck stripping	mvb; multiple seams; 0.8% sulphur	Thermal; (Stage II report in preparation)
Monkman Project	Petro-Canada and others	Shovel-truck stripping	mvb; Seams No. B1,B3,B4,B9 and and others; 0.4-0.5% sulphur	Thermal and some metallurgical
Sukunka Project	B.P. Canada Ltd.	Room-and-pillar, in	mvb; Bird Seam, Upper and Lower Chamberlain Seams	Metallurgical coal; (Stage II report approved Mar/81)

NOTE: *** Projects assigned to PART III: Coal Projects in the Planning-Development Stage are those in Alberta which have either received approval-in-principle as set forth in preliminary disclosure, or have received approvals for test pits. In British Columbia approval-in-principle is considered to be the approved Stage II submission. Those projects with either Stage II approvals or with work underway for Stage II submissions have been included.

The assessment procedure for new coal projects in Alberta and British Columbia is detailed in reference (8) and (9) respectively.

APPENDIX E

APPENDIX E - Classification of Coals by Rank (ASTM)
(after Report ER 79-9)

Basis of Classification (Figure 2)

The rank classification outlined in Figure 2 is based on volatile matter, fixed carbon and heating value in Btu per pound. The higher-rank coals are classified according to fixed carbon on a dry, mineral-matter-free basis; the lower-rank coals are classified according to heating value on moist, mineral-matter-free basis. Agglomerating character is used to differentiate between certain adjacent groups. Classify coals having calorific values of 14,000 Btu/lb (32.6 MJ/kg) or more on the moist, mineral-matter-free basis and coals having fixed carbon of 69 percent or more on the dry, mineral-matter-free basis, according to fixed carbon on the dry, mineral-matter-free basic; classify coals having calorific values less than 14,000 Btu/lb (32.6 MJ/kg) on the moist-mineral-matter-free basis, provided the fixed carbon on the dry, mineral-matter-free basis is less than 69 percent.

Medium volatile bituminous (mvb) - fixed carbon less than 78 percent, and greater than or equal to 69 percent; volatile matter greater than 22 percent and equal or less than 31 percent.

High volatile A bituminous (hvAbv) - fixed carbon less than 69 percent; volatile matter greater than 31 percent; heating value greater than or equal to 14,000 Btu per pound (32.6 MH/kg).

High volatile B bituminous (hvBb) - heating value less than 14,000 Btu per pound (32.6 MJ/kg), and greater than or equal to 13,000 Btu per pound (30.2 MJ/kg).

High volatile C bituminous (hvCb) - heating value less than 13,000 Btu per pound (30.2 MJ/kg), and greater than or equal to 11,500 Btu per pound (26.7 MJ/kg).

I. Anthracitic Class - Nonagglomerating

Meta-anthracite (ma) - fixed carbon greater than or equal to 98 percent; volatile matter equal or less than 2 percent.

Anthracite (an) - fixed carbon less than 98 percent and greater than or equal to 92 percent and equal or less than 8 percent.

Semianthracite (sa) - fixed carbon less than 92 percent, and greater than or equal to 86 percent; volatile matter greater than 8 percent and equal or less than14 percent; if agglomerating classify as low volatile.

II Bituminous Class - Commonly Agglomerating

Low volatile bituminous (lvb) - fixed carbon less than 86 percent, and greater than or equal to 78 percentl volatile matter greater than 14 percent and equal or less than 22 percent.

III Subbituminous Class - Nonagglomerating

Subbituminous A (SubA) - heating value less than 11,500 Btu per pound (26.7 MJ/kg), and greater than or equal to 10,500 Btu per pound (24.4 MJ/kg); if agglomerating classify as high volatile C biluminous.

Subbituminous B (subB) - heating value less than 10,500 Btu per pound (24.4 MJ/kg, and greater than or equal to 9,500 Btu per pound (22.1 MJ/kg).

Subbituminous C (subC) - heating value less than 9,500 Btu per pound (22.1 MJ/kg), and greater than 8,300 Btu per pound (19.3 MJ/kg).

IV Lignitic Class - Nonagglomeating

Lignite A (ligA) - heating value less than 8,300 Btu per pound (19.3 MJ/kg), and greater than or equal to 6,300 Btu per pound (14.7 MJ/kg).

Lignite B (ligB) - heating value less than 6,300 Btu per pound (14.7 MJ/kg).

APPENDIX F

APPENDIX F - QUALITY CHARACTERISTICS OF COAL IN CANADA, BY REGION AND COALFIELD (continued)

Region/Coalfield	Rank	Current use (potential use)	Proximate analysis % (1 run-of-mine coal, 2 clean coal) M	A	VM	FC	Sulphur %	Heating value (moist basis) MJ/kg	Remarks
NOVA SCOTIA									
Sydney Coalfield	hvb	70% thermal 30% metallurgical	1 5-8	10-18	29-32	45-55	1-4	24-31	low ash, variable sulphur, high reactivity
			2 2-8	3-12	29-35	54-62	1-2.5	30-34	
NEW BRUNSWICK									
Minto Coalfield	hvb	thermal	1 1-3	15-20	31-34	47-50	6.8		high sulphur, high ash
SASKATCHEWAN									
Estevan Coalfield	lig	thermal	1 28-35	8-15	26-31	29-34	0.4-0.6	14-17	
Willow Bunch Coalfield	lig	thermal	1 36-40	10-13	21-24	26-27	0.5	12-13	high moisture
ALBERTA PLAINS									
Battle River Coalfield	sub	thermal	1 23-25	6-12	30-35	36-38	0.3-0.4	18-20	
Lethbridge Coalfield	sub-hvb	(thermal)	1 9.5	10-20	35.5	36-44	0.5-0.6	21-24	
Sheerness Coalfield	sub	thermal	1 24-27	11-18	25-28	33-37	0.4-0.5	17-18	
South Swan Hills Coalfield	sub	(thermal, chemical feedstock)	1 22-24	21-22	24-26	30-31	0.1	15-16	variable quality
Wabamun Coalfield	sub	thermal	1 20-22	15-17	26-27	35-38	0.2-0.3	17.5-19.5	
Wetaskiwin Coalfield	sub	(thermal)	1 18-20	13-16	27-28	36-38	0.3-0.4	19-20	
ALBERTA FOOTHILLS									
Coalspur Coalfield	hvb	thermal	1 11	24-25	28	37	0.4-0.5	21	variable quality; clay bands in coal demand selective mining
			2 8.5-9.5	8-10	33	49	0.3	26	
Obed Marsh Coalfield	hvb	(thermal, chemical feedstock)	1 16-20	30-31	33	20	0.5	19	
			2 7-8	12-13	36	44	0.5	20	

APPENDIX F - QUALITY CHARACTERISTICS OF COAL IN CANADA, BY REGION AND COALFIELD (continued)

Region/Coalfield	Rank	Current use (potential use)	Proximate analysis % (1 run-of-mine coal, 2 clean coal)				Sulphur %	Heating value (moist basis) MJ/kg	Remarks
				M	A	VM	FC			
ALBERTA MOUNTAINS									
Caloutn Luscar Coalfield	mvb	metallurgical (thermal)	1	5	12-20	18-20	55-65	0.3	30-31	
			2	8	10	22-24	58-60			
Smoky River Coalfield	lvb	metallurgical and some thermal	1	4	17-20	16	60-63	0.4	28	
			2	6	7	18	65-69	0.4	34	
BRITISH COLUMBIA										
Comox Coalfield	hvb	(thermal)	1	6	15.8	32.7	45.5	1.1	26	composite from 3 seams in Quinsam Project
			2	6.7	NA	NA	NA	NA		
Crowsnest Coalfield	lvb-mvb	metallurgical and thermal	1	4-5	15-20	19-23	55-60	0.3-0.4	30-31	clean thermal coal has higher ash and lower heating value
			2	8	9-10	2-22	59-61	0.3-0.4	3-33	
Elk Valley Coalfield	lvb-mvb	metallurgical	1	3-5	20-35	19-33	40-60	0.3-0.5	20-25	several blends of clean coal are produced
Flathead Coalfield	mvb	(thermal, metallurgical)	1	3-6	25-35	22	40-50	0.5	20-25	% VM is an average
			2	NA	NA	NA	NA	NA		
Hat Creek Coalfield	lig-sub	(thermal, chemical	1	23	32	24	21	0.4	11.6	values shown are averages for a highly variable coal
Peace River Coalfield	mvb	(metallurgical and thermal)	1	6	20-30	21-27	45-55	0.3-0.5	21-26	
			2	6-8	6-9	22-24	63-66	0.3-0.5	33-36	clean metallurgical coal
			2	8	16	20	56	0.3-0.5	28-30	clean thermal coal

Abbreviations used for rank: lig - lignitic; sub - subbituminous; hvb - high volatile bituminous; mvb - medium volatile bituminous; lvb - low volatile bituminous

Abbreviations used for proximate analysis: M - moisture; A - ash; VM - volatile matter; FC - fixed carbon

APPENDIX G

APPENDIX G - CLASSIFICATION OF COAL BY RANK' BASED ON COAL ANALYSIS

Canada uses the systems and procedures of the American Society for Testing and Materials (ASTM) for sampling, analysing and classifying coals by rank, as detailed in the Annual Book of ASTM Standards (7). Basically coals are ranked according to their degree of metamorphism, or progressive alteration, in the natural series from lignite to anthracite.

Classification in the ASTM system is a function of fixed carbon content and calorific value calculated to the mineral-matter-free basis. The higher-rank coals are classified according to fixed carbon on the dry basis whereas the lower-rank coals are classed according to calorific value on the moist basis. The agglomerating characteristics of coals (i.e. their binding and/or swelling qualities when heated in the absence of oxygen) are used to differentiate between certain adjacent groups in the ranking. Figure 2 summarizes the ASTM classification of coal by rank and Appendix "D" provides details.

The approved abbreviations (7) of the rank of coal by group are noted below:

ma = meta-anthracite
an = anthracite
sa = semianthracite
lvb = low volatile bituminous
mvb = medium volatile bituminous
hvAb = high volatile A bituminous
hvBb = high volatile B bituminous
hvCb = high volatile C biluminous
subA = subbituminous A
subB = subbituminous B
subC = subbituminous C
ligA = lignite A
ligB = lignite B

The proximate analysis of coal (and coke) by definition (10) is the assay of the moisture, ash and volatile matter and the calculation of fixed carbvon by difference. In other words ... % fixed carbon = 100 - (% moisture + % ash + % volatile matter), with all percentage on the same moisture reference

VM%*	FC%*	CLASS	GROUP	CALORIFIC VALUE **	
				Btu per lb	Mj/kg
2	98	ANTHRACITIC (1)	META-ANTHRACITE		
8	92		ANTHRACITE		
14	86		SEMIANTHRACITE		
22	78	BITUMINOUS(2)	LOW VOLATILE BITUMINOUS		
31	69		MEDIUM VOLATILE BITUMINOUS		
			HIGH VOLATILE A BITUMINOUS	14 000	32.6
			HIGH VOLATILE B BITUMINOUS	13 000	30.2
			HIGH VOLATILE C BITUMINOUS	11 500	26.7
		SUBBITUMINOUS(4)	SUBBITUMINOUS A(3)	10 500	24.4
			SUBBITUMINOUS B	9 500	22.1
			SUBBITUMINOUS C	8 300	19.3
		LIGNITIC(4)	LIGNITE A	6 300	14.7
			LIGNITE B		

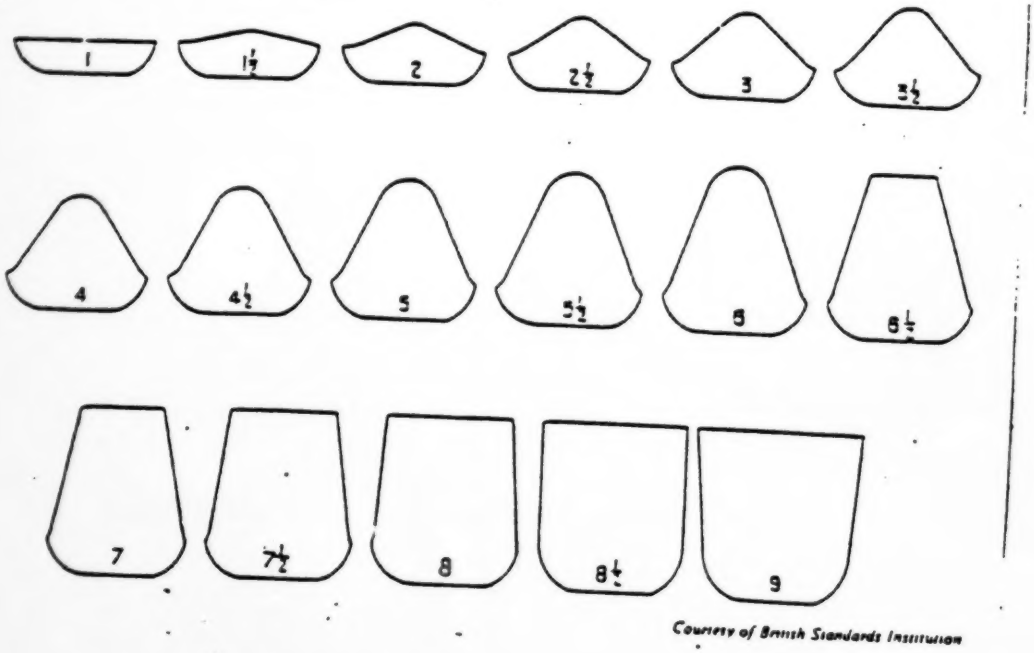
*Dry, mineral-matter-free basis
**Moist, mineral-matter-free basis
(1) Non-agglomerating; if agglomerating classified as low volatile bituminous
(2) Commonly agglomerating
(3) If agglomerating classified as high volatile C bituminous
(4) Non-agglomerating
VM: Volatile matter
FC: Fixed carbon

Fig.1 - Summarized classification of coal by rank

base. Other constitutents such as sulphur and phosphorus are not included with proximate analyses.

The term ultimate analysis as applied to coal (and coke) is by definition (7) the determination of carbon and hydrogen in the material, as found in the gaseous products of its complete combustion, the determintion of sulphur, nitrogen, and ash in the material as a whole, and the calculation of oxygen by difference. The determination of phosphorus or chlorine is not a partr of the ultimate analysis of coal. Moisture is not a part of the ultimate analysis of coal but must be determined in order that analytical data may be connected to bvases other than that of the analysis sample. As some coals cointain mineral carbonates, and practically all coals contain clay or shale which in turn contain combined water, a part of the carbon, hydrogen, and oxygen found in the products of combustion may arise from these mineral components.

The Free-Swelling Index (FSI) of coal is a number ranging from 1 to 9 based on a small-scale test of the free-swelling properties of coal. The results may be used as an indication of the caking characteristic of the coal when burned as a fuel, and hence is an indicator of the coals suitability for coke-making purposes. Basically, the test involves a one gram sample being heated in a covered crucible and the resulting coke button's profile being compared with the series of standard profiles shown in Fig. 2.



Courtesy of British Standards Institution

Fig. 2 - Full-scale standard profiles and corresponding Free-swelling Index (FEI) numbers, after reference (7)